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AN INTERACTIVE COMPUTER AIDING SYSTEM
FOR GROUP DECISION MAKING

Steven Johnston
Randall Steeb

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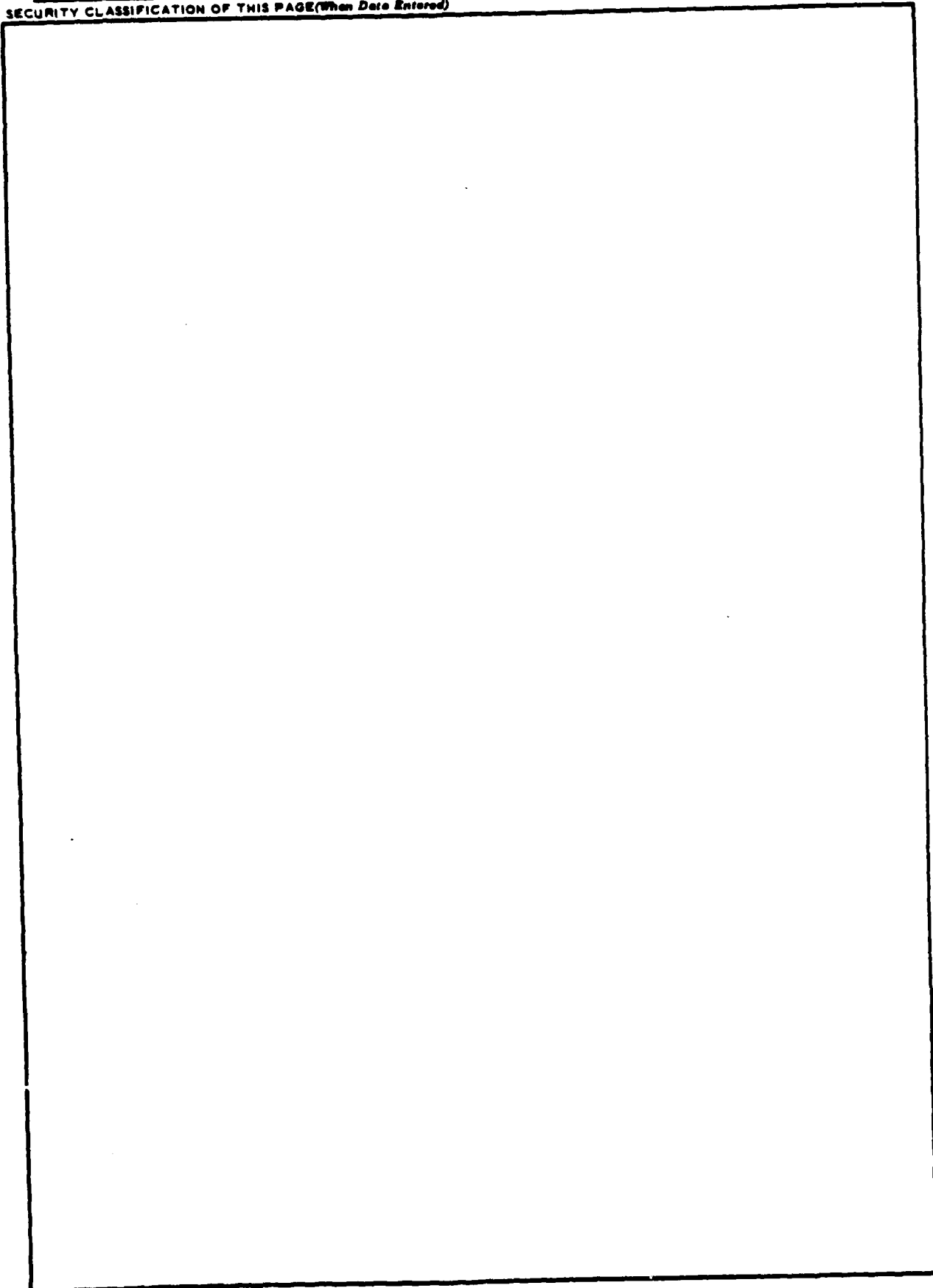MAR 2 4 1980
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report describes progress on work cenetred on the transfer of an interactive computer aid for group decision making to the DARPA/CTO Demonstration and Development Facility. The report includes: (1) implementation details of both the black and white version and the color version, (2) a description of software support modules required for system integration as a generalized demonstration program at the DDF, (3) the design description of the Group Aid/CACI Excutive Aid integration, and (4) a progress report on the full scale experimental studies currently being administered.

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1. Summary

1.1 Report Period

The ninth quarter of contract activity involved (1) continued software development and implementation required to transfer the Group Decision Aid to the Demonstration and Development Facility (DDF) of DARPA's Cybernetic Technology Office; (2) analysis and design of software required to interface the Group Aid with other DDF decision aids; and (3) continuation of full scale experimental studies of the Group Decision Aid. The following specific tasks were accomplished during the report period.

(1) All major components of the black and white version of the Group Aid were completed and tested. A subsequent design and implementation effort of a color version of the Group System commenced which included additional software required to support the Group Aid as a demonstration system at the DDF.

(2) A design was completed for interfacing the Group Decision Aid with CACI's Executive Aids. During the course of a decision making session the Intermediator will be able to switch between the Group Aid and Executive Aid by pressing a single button. Useful information displayed to the group by the Executive Aid can be interactively transferred to the Group System by the Intermediator. This capability of immediate review of U.S. actions and objectives during past crisis will greatly enhance tree expansion by a decision making group.

(3) Full scale experimental studies are in progress at Perceptronics' California office. The previously completed experimental hypotheses and the CACI-developed scenario are the guiding factors for the experiments. Several experimental groups have completed the briefing and aiding sessions. It is anticipated that experiments will be run with subject groups over the next period of contract activity.

1.2   Next Period

The contract activity during the next quarter will primarily concentrate on the completion of the Group Aid transfer to the DDF and its integration with the CACI Executive Aid. This includes integration of support software into the color version of the Group Aid that will facilitate its integration as a generalized demonstration program at the DDF. In addition, system evaluation studies will continue. The specific items of work for the next period include:

(1) Operational testing of the color version of the Group Aid at the DDF.

(2) Implementation of Group Aid support modules including on-line tutorial information presenting decision theoretic concepts, attribute definition and scaling, and a mechanism to allow different Intermediators the capability to save and restart their decision-making sessions.

(3) Implementation of the Group Aid integration with the CACI Executive Aid.

(4) Completion of full scale experimental studies of Group Decision Aiding.

1.3   Program Milestones

The milestone chart for the contract program is shown in Figure 1-1, with the report period illustrated as the shaded portion.

PROGRAM TASK

1. **Transfer Activities**
   Black and White Version
   - implementation completed
   - testing completed

   Color Version
   - requirements analysis
   - design and implementation completed
   - testing completed

   Support Software
   - design of on-line tutorial information
   - design of independent Intermed. capability
   - implementation of demonstration start-up procedures

2. **Integration of Group Aid w/ CACI Executive Aid**
   - Design Implementation
   - Integrated Aid Testing

3. **Evaluation Studies**
   - Group Experiments

4. **Preliminary Evaluations**

5. **Report and Guidelines**

Months ARC

18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

TABLE 1-1   PROGRAM MILESTONES

2. PROGRAM OVERVIEW

2.1   Statement of Problem

Constant escalation in weapons cost and effectiveness, as well as increasing complexity of international relations, makes military decision making more critical today than ever before. In today's military environment, most upper-level decisions are made by committees and staff groups. Typically, such groups contain experts from several speciality areas, who bring to the decision environment disparate sets of values. Decision time is usually limited, the decision making procedure is relatively unstructured, and intragroup conflicts arise on a broad variety of issues. Consequently the group is unable to consider the maximum sets of alternatives, conflicts are not resolved in an optimum manner, and the resultant decision is rarely up to the aggregate potential of the group membership.

2.2   Rationale

Decision analysis offers a promising appproach to solving these problems. The analytical procedure of building a decision tree formalizes the decision process, and permits incorporation of individual values (utilities) into the selection of alternative courses of action (Hays, O'Connor, and Peterson, 1975). However, decision analysis as it is usually practiced, is a highly personal and time-consuming process. Decision analysts are often called upon to assist in the solution of problems ranging over a large variety of domains. In most cases, the decision analysts know far less about the problem domain than do their clients. Thus, their contributions are confined primarily to the phases of formalization and optimization. While optimization is usually computer assisted, the formalization phase invariably has been accomplished.

manually, using lengthy interviews of persons more familiar with the problem area. This approach is generally incompatible with the conditions of command group decision making.

Accordingly, it would be highly worthwhile to automate the formalization phase, using an interactive computer system to interrogate the group members and to construct a decision tree based on their responses. The purpose of the research undertaken here is to develop and evaluate the means by which such an interactive aid could be used to improve group decision making.

2.3   Objectives

The goal of the research program addressed in this progress report is to develop an automated decision tree elicitation system using on-line sensitivity analysis with direct real-time group feedback and evaluate its effectiveness in aiding group decision making.

The specific objectives of the current program include the following:

(1)   Develop computer programs for efficient, comprehensive, elicitation of decision trees from a decision making group.

(2)   Develop computer programs for identifying structural and numerical differences among the contributions of individual group members, for merging these contributions and for resolving the points of conflict.

(3)   Develop effective means for displaying to the group the results of the elicitation procedures and conflict analyses.

(4)   Integrate the various programs and techniques into a complete aiding system which can be readily transferred

to other test environments.

(5) Experimentally test the Group Decision Aid, using a variety of representative military decision problems, to demonstrate its advantages under realistic conditions of use.

(6) On the basis of the developmental effort and the experimental results, establish guidelines and recommendations for future military applications of the group decision aiding methodology.

3. TRANSFER OF GROUP DECISION AIDING SYSTEM TO DARPA/CTO DEMONSTRATION AND DEVELOPMENT FACILITY

3.1   Overview

The Group Decision Aiding System developed by Perceptronics is being transferred to the Demonstration and Development Facility (DDF) of DARPA's Cybernetic Technology Office. The system has undergone thorough review and evaluation in order to provide a viable and easily useable DDF demonstration system.

3.2   The Demonstration and Development Facility

The DDF is organized around a Digital Equipment Corporation PDP 11/70 with 256K words of memory and a large capacity disk. The 11/70 generally serves two functions: (1) provides interactive computing and support to contractors in development of ARPA programs and (2) supports a number of graphics, special purpose, and imaging systems used in the demonstration of concepts from research programs. The physical computing facility is illustrated in Figure 3.1. The demonstration room at the DDF contains an Advent large screen projection system, 11/70 connected graphics terminals in both 'black and white' and color, and several stand-alone special purpose devices. Large groups can easily be given demonstrations in this specially designed facility.

3.3   Transfer Activities

3.3.1   Black and White Version of Group Aid. The initial Group Aid transfer was completed and tested using the Tektronix 4025 black and white graphics terminal. Although the Tektronix provides only a black and white video output signal of what is displayed on its screen, it allows greater flexibility of use in two aspects: (1) it is attached to the computer in the same manner as any interactive terminal thus eliminating the need for operating system software to control it, and (2) it is upward compatible with a wide range of Tektronix terminal graphics system thereby guaranteeing future ease of transference of Group Decision Aiding software.
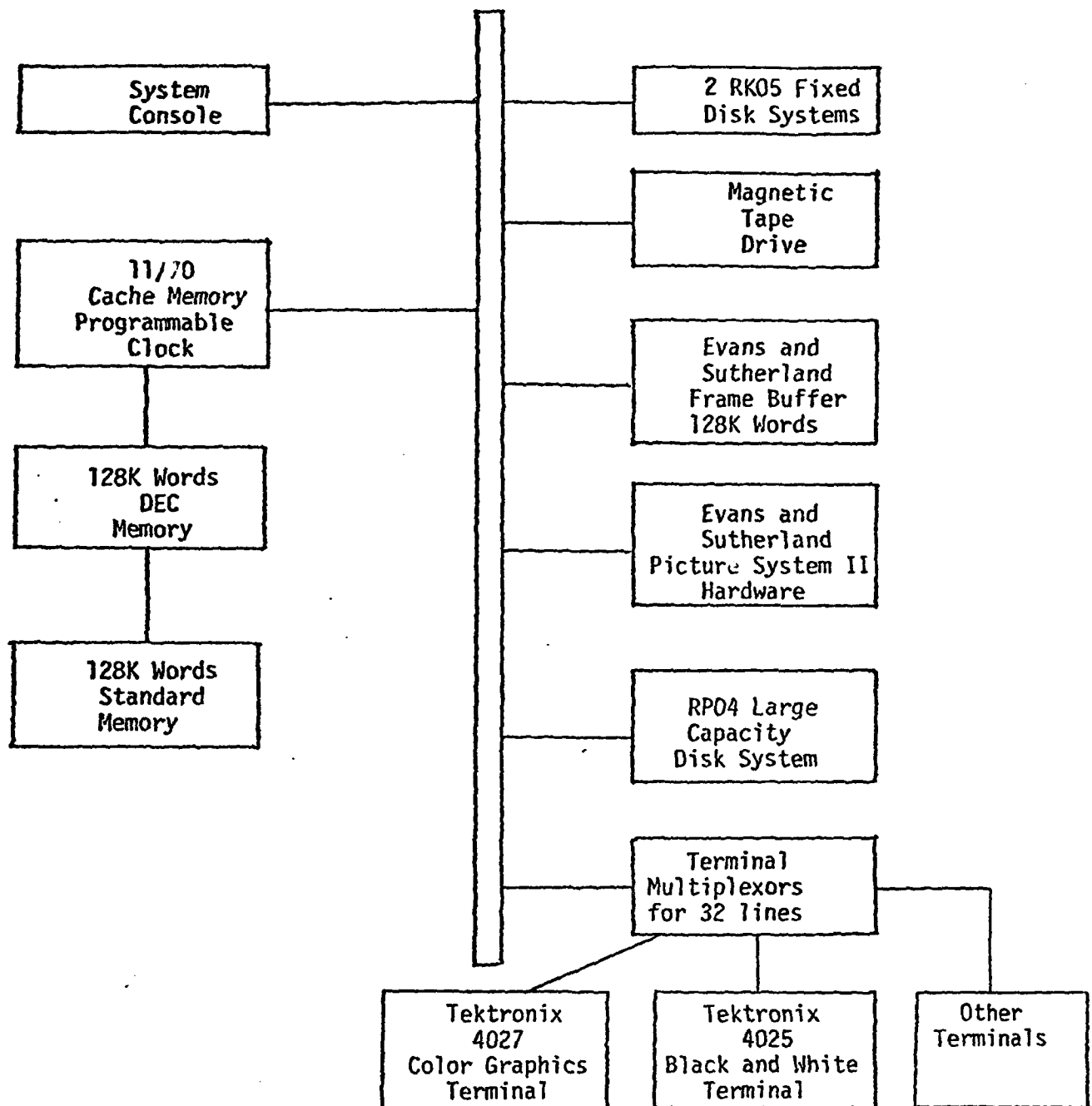
FIGURE 3.1 THE DDF COMPUTING FACILITY

All primary components of the Group Aid software were successfully tested and exercised using the 4025 as the group display component. Features of the 4025 such as variable line types (solid, dotted, dashed, etc.) and field highlighting were used to replace color accentuation used in the original Genisco based color graphics system.

3.3.2 Color Version of Group Aid. At the request of ARPA, an analysis was performed to determine the extent of additional software development required to implement the Group Decision Aid using the Tektronix 4027 color graphics terminal recently installed at the DDF. The analysis outcome indicated that the graphics command language of the 4027 is a super set of 4025 graphics commands. It became apparent that only moderate and easily identifiable modifications of the black and white version would be required to implement a color version on the 4027.

The initial modular top-down design and implementation of the Group System software was instrumental in minimizing the amount of software modification necessary to accomodate the graphics' format of the Tektronix 4025 terminal. Figure 3.2 illustrates the main components of the Group software. Two modules of the existing group software were replaced by a Tektronix interface module which transforms the Genisco access control mechanisms used by the primary Group software modules into simple Tektronix control functions. Another layer of procedures was added to the "Tektronix Display raster selection and graphics generation module" providing color display capability in the Group Aid software. The new module now fully emulates the original Genisco color graphics system.

3.3.3 Demonstration Software Support. The Group Decision Aid was implemented at Perceptronics' Woodland Hills, California facility under the context that demonstrations and experiments would be directed by a trained, in-house Intermediator in a static system environment. Transferring the Group Aid to the DDF required the development of support software to facilitate the integration of the Aid as a generalized demonstration program. The system would have to accomodate a number of different Intermediators and allow

PRIMARY GROUP DECISION AID SOFTWARE MODULES

Tree Display

Genisco Display
line and column
access control
module

List Modification

Value Elicitation

Genisco Display
raster selection
and graphics
generation
module

Genisco Processor
Instruction
Control
Module

Genisco Control
via PDP 11 UNIBUS
access

Replaced by

Conflict Resolution

4027 Color Graphics
procedures

Tektronix Display
raster selection
and graphics
generation module
for 4025/4027

Tektronix Control
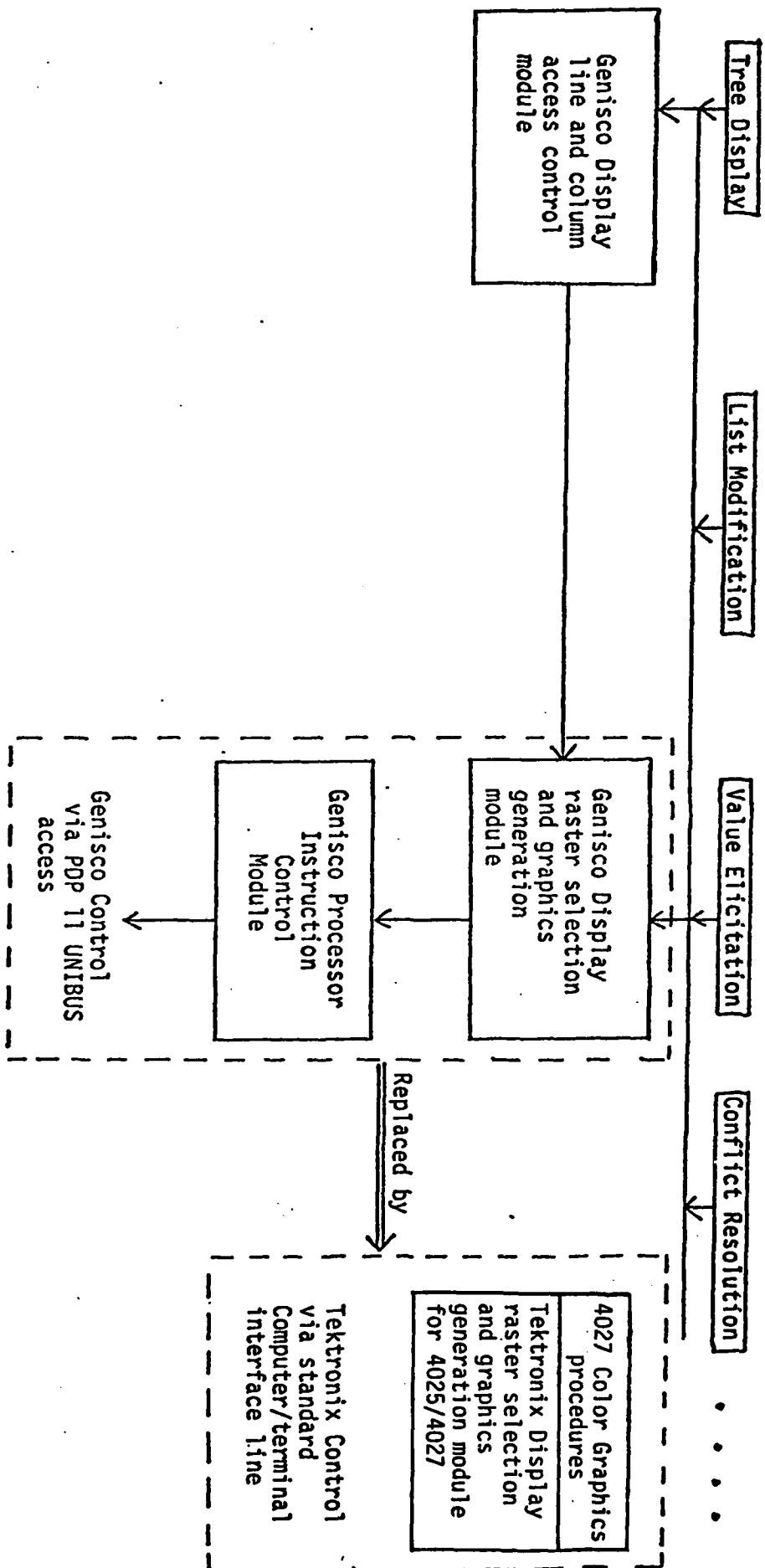via standard
Computer/terminal
interface line

FIGURE 3.2 GROUP SYSTEM SOFTWARE COMPONENTS

start-up by new system support personnel. In addition, groups of people
viewing the system would benefit from on-line briefing material describing
the operation and theory of the Group Decision Aid. The following paragraphs
describe the support modules in more detail.

Independent Intermediators Support. When assuming the role of the Intermediator
in the Group Aid, a person enters their last name for identification. The
Intermediator can then identify the participants and choose to begin a new
decision session or continue a previous one. In the former case, the Inter-
mediator provides a short description which is included in a save file when
the session terminates providing a means of differentiating among many saved
decision sessions at a later time. The framework for an Intermediators
manual was defined. The manual will provide in-depth instruction on the
operation of the Group Aid.

System Personnel Support. Procedures were designed and integrated into the
Group System facilitating system start-up, defining device/computer connec-
tions, and establishing the run-time environment.

On-Line Tutorials. Modules were designed to provide on-line tutorial infor-
mation to participants. These modules can be invoked selectively by the
Intermediator to provide background information as required. On-line
information available includes: (1) displays presenting decision-theoretic
concepts, (2) displays describing operation of the AID, (3) graphical
frames giving information on attribute definition, scaling, and weighting,
and (4) a description of the multi-attribute utility measurement model (MAUM)
used to resolve conflicts.

4. Integration of Group Aid with CACI Executive Aid

4.1 Overview

When faced with analyzing and planning strategy for international situations, U.S. decision makers at the highest military and diplomatic levels often examine past U.S. responses to crises. A large informational data base and an interactive access/display system has been implemented by CACI at the DDF. This Executive Aid (XAID) allows a person to examine U.S. actions and objectives associated with past crises. One advantage of interconnecting the Executive Aid and the Group Aid is to provide real-time access to the XAID database by a group of decision-makers who are using the Group Decision Aid. Another advantage is that U.S. actions and objectives associated with past crises but relevant to the current situation can automatically be selected for use during the decision-tree expansion process. These features will allow a group of decision makers to (1) more thoroughly analyze a decision problem and (2) more efficiently formulate strategy, resulting in a decision tree where each path in the tree represents a different scenario as a sequence of actions and probabilistic events.

4.2 Functional Description of Executive Aid

The Executive Aids/USA are composed of three sub-programs: (1) Action/ Objective Executive Management Aid, (2) Crisis Management Problem Analyzer, and (3) Crisis Management Data System. Figures 4-1 through 4-3 demonstrate the use of sub-program 1: U.S. Actions/Objectives Executive Management Aid in crises involving the U.S. between 1956 and 1976. The first three options of sub-program 1 were exercised and the resulting displays are shown in figures 4-4 through 4-11.

The capabilities of each XAID sub-program and the utility of each option (in the context of the Group Decision Aid) is listed below. The notation

used to indicate information usefulness to the decision makers during the session is as follows: * highly useful, + somewhat useful, - not useful.

Sub-program 1: U.S. Actions/Objectives of crises between 1956 and 1976:
* list 57 U.S. actions
* list 48 U.S. objectives
* list 101 crisis
* find crisis using objectives
* find crisis using actions
* display actions/objectives for a crisis
* examine U.S. actions for a set of objectives

Sub-program 2: Crisis Management Problem Analyzer
+ list 101 crisis
+ list 79 problems
+ find crisis using problems
- plot crisis using selected problems
+ display problems in specific crisis

Sub-program 3: Crisis Management Data System
+ list 307 crisis
- list crisis descriptors
- select crisis by descriptors
- display descriptors for selected crises

Although all three XAID sub-programs can be invoked when using the Group Aid it is expected that the '*' and '+' options will prove most useful to the group members.

4.3   Design Implementation

The capabilities of the Executive Aid described in the previous section will be accessible to a group of decision makers during a decision

session. On the Intermediators terminal will be two control buttons labelled XAID and GROUP AID. The Intermediator will be able to switch between either program as required. In addition, prompting by the Group Aiding System will alert users of Executive Aid capabilities. Interconnected Group Aid/Executive Aid operation is characterized by the computer controlled sharing of the Large Screen Display.

The modular components of an intergrated XAID/Group Aid system are illustrated in Figure 4-12. The control process (CP) maintains current display information for both the XAID and the Group Aid allowing the last displayed frame of either process to be shown on the Large Screen Display. The control process also interprets commands and passes data between the two sub-processes.

Information transmitted over the communication channels is of the following types.

A. Between the Control Process and the Group Decision Aid Process
   1. GDA to CP
      information packets
         - graphics and text display commands
         - XAID exerciser commands
   2. CP to GDA
      information retrieval
         - specific items from XAID data base
         - actions taken during specified crisis
         - objectives for specified crisis
B. Between the Control Process and the XAID Process
   1. CP to XAID
      operational commands
   2. XAID to CP
      information packets
         - graphics and text display commands
         - current textual output from XAID program

The functionality of the three processes is described in the following paragraphs labelled A, B, and C.

A. Group Decision Aid Process
   1. normal group operation
      - decision tree elicitation
      - decision recommendation
   2. information required from XAID
      - during initial problem discussion examine past similar crisis
      - during attribute definition select U.S. objectives to use as attributes
      - use attributes (objectives) to select past similar crisis, examine U.S. actions in those crises
      - during action alternative generation select actions from past similar crisis to use in node expansion
   3. intermediator provides input to Control process

B. Control Process
   1. maintain display control of large screen display for both GDA and XAID output
   2. interpret and process commands from GDA
   3. send appropriate control information to XAID process
   4. filter information generated by XAID process
   5. reformat XAID information for display on LSD
   6. compose information packets when communicating with GDA process

C. XAID Process
   1. normal operation
      - receives input commands from Control Process
      - transmits graphics commands and text which normally is directed to TEK 4027 but will first be filtered through the Control process.

Executive Aids/USA

☒ ACTION/OBJECTIVE EXECUTIVE MANAGEMENT AID

☐ CRISIS MANAGEMENT PROBLEM ANALYZER

☐ CRISIS MANAGEMENT DATA SYSTEM

☐ ASCEND TO CRISIS MANAGEMENT PROGRAM MENU

type "u" to move cursor up, "d" to move down, and "x" to execute

Figure 4-1

executive aids for crisis management

program 1. u s actions/objectives executive management aid

this program allows you to examine u s actions and objectives in a set
of crises involving the u s between   1956 and 1976

Figure 4-2

```
╭────────────────────────────────────────────────────────╮
│         Action/Objective Executive Management Aid        │
│                                                          │
│         ┌───┐                                            │
│         │ X │  LIST 57 US ACTIONS                        │
│         └───┘                                            │
│         ┌───┐  LIST 48 US OBJECTIVES                     │
│         └───┘                                            │
│         ┌───┐  LIST 101 CRISES                           │
│         └───┘                                            │
│         ┌───┐  FIND CRISES WITH SELECTED US OBJECTIVES   │
│         └───┘                                            │
│         ┌───┐  FIND CRISES WITH SELECTED US ACTIONS      │
│         └───┘                                            │
│         ┌───┐  DISPLAY ACTIONS/OBJECTIVES FOR A CRISIS   │
│         └───┘                                            │
│         ┌───┐  EXAMINE US ACTIONS FOR A SET OF OBJECTIVES│
│         └───┘                                            │
│         ┌───┐  EXIT                                      │
│         └───┘                                            │
│                                                          │
│                                                          │
│  type "u" to move cursor up, "d" to move down, and "x" to execute │
│  ▬                                                       │
╰────────────────────────────────────────────────────────╯
```

Figure 4-3

u s actions
_____

    1 COMMIT LAND FORCES TO COMBAT
    2 COMMIT SEA FORCES TO COMBAT
    3 COMMIT AIR FORCES TO COMBAT
    4 COMMIT SUPPORT SERVICES (LAND)
    5 COMMIT SUPPORT SERVICES (SEA)
    6 COMMIT SUPPORT SERVICES (AIR)
    7 REPOSITION LAND FORCES
    8 REPOSITION SEA FORCES
    9 REPOSITION AIR FORCES
   10 THREATEN NUCLEAR FORCES AS A DETERRENT
   11 REDEPLOY NUCLEAR FORCES AS A DETERRENT
   12 CHANGE ALERT STATUS OF NUCLEAR FORCES AS A DETERRENT
   13 THREATEN NONNUCLEAR FORCES AS A DETERRENT
   14 REDEPLOY NONNUCLEAR FORCES AS A DETERRENT
   15 CHANGE ALERT STATUS OF NONNUCLEAR FORCES
   16 REDEPLOY PEACEKEEPING FORCES
   17 SHOW OF MILITARY FORCE
   18 MILITARY BLOCKADE OR QUARANTINE
   19 ISOLATED MILITARY CONTACT
   20 MILITARY FORCES USED IN SEARCH AND RESCUE OPERATION
   21 MILITARY INTELLIGENCE COLLECTION
   22 MILITARY INTELLIGENCE DISSEMINATION TO AN ALLY
   23 MILITARY INTELLIGENCE PROVIDED TO AN ANTAGONIST
   24 MILITARY MANEUVERS OR TRAINING EXERCISES
   25 IMPROVE, MAINTAIN FORCE READINESS
   26 COVERT MILITARY OPERATION
   27 MILITARY INTERVENTION BETWEEN COMBATANTS
   28 AIRLIFT PERSONNEL AND/OR SUPPLIES AND EQUIPMENT

Figure 4-4

```
29 PROVIDE MILITARY ADVISORY ASSISTANCE
30 PROVIDE MILITARY TRAINING FOR COMBAT TROOPS
31 PROVIDE OTHER MILITARY TRAINING
32 DRAWDOWN MILITARY EQUIPMENT FROM U.S. UNITS
33 PROVIDE SUPPLIES FROM U.S. DEPOTS
34 PROVIDE SUPPLIES FROM NON-MILITARY SOURCES
35 PROVIDE MILITARY MAINTENANCE ASSISTANCE
36 PROVIDE OTHER MILITARY LOGISTICS ASSISTANCE
37 PROVIDE OTHER MILITARY ASSISTANCE
38 MAKE POL/ECO COMMITMENT IMPLYING NEW MIL MISSION
39 UNDERTAKE A NEW MILITARY MISSION
40 ACCEPT A NEW MILITARY COST
41 MODIFY AN EXISTING DEFENSE TREATY
42 MODIFY AN EXISTING BASE RIGHTS TREATY
43 MODIFY AN EXISTING STATUS OF FORCES AGREEMENT
44 SEEK ASSISTANCE IN DECISION-MAKING
45 TAKE NO MILITARY ACTION
46 EMPLOY DIPLOMACY
47 MEDIATE A DISPUTE
48 THREATEN TO, OR ACTUALLY, WITHDRAW SUPPORT
49 ADVOCATE/SUPPORT PEACEKEEPING EFFORTS
50 IMPROVE SCIENTIFIC/TECHNICAL CAPABILITIES
51 REAFFIRM EXISTING POLITICAL/MILITARY COMMITMENT
52 LODGE PROTEST(S)
53 OTHER
54 U.S. ACTS ALONE
55 U.S. ACTS WITH ONE OTHER NATION
56 U.S. ACTS WITH TWO OR MORE OTHER NATIONS
```

Figure 4-5

u s objectives
_____

    1 DETER IMMINENT ATTACK
    2 IMPROVE OR RECTIFY DETERRENCE POSTURE
    3 PUT DOWN REBELLION
    4 RESTORE A REGIME
    5 REGAIN ACCESS TO ECONOMIC RESOURCES
    6 RESTORE PEACE
    7 RESTORE TERRITORIAL INTEGRITY
    8 RESTORE MILITARY BALANCE OF POWER
    9 RESTORE READINESS
    10 PRESERVE READINESS
    11 PRESERVE PEACE
    12 CONFIRM OR RE-ESTABLISH PRESTIGE
    13 PRESERVE TERRITORY AND/OR FACILITIES
    14 PRESERVE REGIME FROM EXTERNAL THREAT
    15 PRESERVE REGIME FROM INTERNAL THREAT
    16 PRESERVE, RESTORE, OR IMPROVE ALLIANCE
    17 PROTECT LEGAL AND POLITICAL RIGHTS
    18 INDUCE MAINTENANCE OF CURRENT POLICY
    19 DISSUADE FROM A NEW POLICY
    20 PROTECT A MILITARY ASSET
    21 SUPPORT A NEW GOVERNMENT
    22 INDUCE NATIONAL REORIENTATION
    23 INDUCE ADOPTION OF A NEW POLICY
    24 BRING ABOUT THE FALL OF A REGIME
    25 SUPPORT INSURGENCY
    26 DENY POLITICAL ACCESS
    27 DENY MILITARY ACCESS
    28 ASSURE CONTINUED ECONOMIC ACCESS

    —

Figure 4-6

29 PRESERVE OR REGAIN CONTROL OF THE SEA
30 PRESERVE OR REGAIN CONTROL OF THE AIR
31 DENY SUCCESS TO TERRORISTS OR HIJACKERS
32 PROTECT HUMAN LIFE
33 PROVIDE SANCTUARY OR ASYLUM
34 SUPPORT CRITICAL NEGOTIATIONS
35 DISCOVER INTENTIONS OR ACTIONS
36 PREPARE FOR ALTERNATIVE MISSIONS
37 SUPPORT EFFORTS BY THE UNITED NATIONS
38 CONTAIN OPPONENT(S)
39 PREVENT SPREAD OF WAR
40 PRESERVE LINE OF COMMUNICATIONS
41 REGAIN TECHNICAL ADVANTAGE
42 RESTORE PRESTIGE
43 PRESERVE BALANCE OF POWER
44 PREVENT SPREAD OF COMMUNIST INFLUENCE
45 PREVENT NUCLEAR PROLIFERATION
46 INSURE SELF-SUFFICIENCY
47 AVOID DIRECT INVOLVEMENT
48 PRESERVE SECRECY

Figure 4-7

crises involving the u s between 1956 and 1976

1 1956 MIDEAST WAR; SUEZ CANAL CRISIS
2 1956 U.S. NAVY P4M SHOT DOWN IN EAST CHINA SEA
3 1956 HUNGARIAN REVOLUTION
4 1957 JORDAN SURVIVES DISMEMBERMENT; OUSTS EGYPTIANS
5 1957 UN COMMAND RENOUNCES KOREAN ARMISTICE
6 1957 CASTRO REVOLUTION; FRICTION WITH U.S.
7 1957 SYRIA/TURKEY - U.S. DISPUTE
8 1957 USSR LAUNCHES SPUTNIK I
9 1958 U.S. MARINES SENT TO LEBANON
10 1958 V.P. NIXON SOUTH AMERICAN VISIT
11 1958 QUEMOY-MATSU SHELLED BY CHINESE COMMUNISTS
12 1958 USSR ORDERS U.S., FRANCE, UK OUT OF BERLIN
13 1958 UNARMED U.S. TRANSPORT SHOT DOWN AT ARMENIAN BORDER
14 1959 USSR TRAWLER "NOVOROSSISK" CUTS MARINE CABLES
15 1959 CUBAN FORCES INVADE PANAMA
16 1959 MATSU ISLAND BOMBARDED BY CHINESE COMMUNISTS
17 1959 INSURGENCY IN LAOS
18 1959 ANTI-U.S. RIOTS IN PANAMA
19 1960 CUBA/U.S. DISSENSION
20 1960 ANTI-U.S. PROTESTS IN JAPAN OVER PEACE TREATY
21 1960 FRANCE BECOMES A NUCLEAR POWER
22 1960 NEW CRISIS IN BERLIN
23 1960 U-2 INCIDENT
24 1960 INITIAL CONGO CRISIS
25 1960 NICARAGUA VS COSTA RICA
26 1961 BAY OF PIGS: OPERATIONAL PHASE
27 1961 DOMINICAN REPUBLIC CRISIS
28 1961 U.S. INCREASES MILITARY SUPPORT TO RVN

Figure 4-8

```
29 1961 PRO-U.S. COUP IN KOREA
30 1961 BERLIN BORDER CLOSED BY EAST GERMANS
31 1961 "SANTA MARIA" INCIDENT: HIJACKING OF PORTUGESE LINER
32 1962 TAIWAN STRAITS CRISIS; QUEMOY, MATSU SHELLED
33 1962 U.S. TROOPS TO THAILAND
34 1962 CUBAN MISSILE CRISIS
35 1962 INDIA-CHINA CONFLICT
36 1962 FRANCE SEEKS "NUCLEAR CLUB" MEMBERSHIP
37 1963 U.S. NAVY TO GULF OF SIAM
38 1963 HAITI-DOMINICAN REPUBLIC DISPUTE
39 1963 DMZ VIOLATIONS IN KOREA
40 1963 CYPRUS TROUBLE; GREEK-TURKISH WAR THREAT
41 1964 CANAL ZONE FLAG RIOTS
42 1964 REBELLION IN ZANZIBAR
43 1969 LIBYA CLOSES U.S. BASE; FRANCE BECOMES SUPPLIER
44 1964 U.S. RECON PLANE SHOT DOWN OVER EAST GERMANY
45 1964 TONKIN GULF INCIDENTS
46 1964 PRC EXPLODES FIRST A-WEAPON
47 1964 COUP IN BRAZIL
48 1964 U.S. SUPPORT TO CONGO
49 1964 CAMBODIA DOWNS U.S. C-123
50 1964 U.S.-CUBA DISCORD: GUANTANAMO
51 1964 FURTHER TENSIONS WITH USSR AND CUBA
52 1965 INSURGENCY IN THAILAND
53 1965 SOVIET HARRASSMENT OF U.S. NAVY SHIPS
54 1965 INDIA-PAKISTAN CONFLICT
55 1965 DOMINICAN REVOLT; U.S. INTERVENTION
56 1966 U.S. DROPS FOUR H-BOMBS OFF SPANISH COAST
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Figure 4-9

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57 1966 FRANCE LEAVES NATO
58 1967 ISRAELI "SIX DAY" WAR
59 1967 USS LIBERTY ATTACKED BY ISRAELIS
60 1968 SEIZURE OF USS PUEBLO BY NORTH KOREANS
61 1968 U.S. JETLINER FORCED DOWN IN KURILES
62 1968 SOVIET INVASION OF CZECHOSLOVAKIA
63 1968 U.S. NAVY IN BLACK SEA
64 1968 JAPAN DEMANDS RETURN OF OKINAWA
65 1969 ANTI-U.S. RIOTS IN ISTANBUL
66 1969 U.S./PERU FISHING AND TRADE DISPUTE
67 1969 USSR/CHINA BORDER CLASH
68 1969 NAVY EC-121 SHOT DOWN BY NORTH KOREANS
69 1969 OPERATION "RED HAT" - MOVEMENT OF TOXIC MUNITIONS
70 1970 "COLUMBIA EAGLE" MUTINY
71 1970 U.S. GENERAL OFFICERS LAND IN ARMENIA
72 1970 JORDAN/PALESTINE GUERRILLAS/SYRIA CONFLICT
73 1971 U.S.-ECUADOR FISHING DISPUTE
74 1971 HELICOPTER SEIZURE IN PHNOM PENH
75 1971 INDIA-PAKISTAN WAR
76 1972 SOVIET SHIPS BOMBED IN HAIPHONG HARBOR
77 1973 LIBYA ATTACKS U.S. C-130
78 1973 MIDEAST WAR
79 1973 ARAB OIL EMBARGO
80 1973 U.S. WORLDWIDE ALERT
81 1973 IDI AMIN OUSTS MARINES
82 1973 PANAMA CANAL NEGOTIATIONS
83 1974 MILITARY COUP IN PORTUGAL
84 1974 INDIA EXPLODES NUCLEAR DEVICE
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Figure 4-10

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85 1974 CYPRUS CIVIL WAR; TURKISH INVASION
86 1975 U.S. ENDS AID; TURKS CLOSE U.S. BASES
87 1975 OPERATION "EAGLE PULL" - EVACUATION OF CAMBODIA
88 1975 U.S. EVACUATION OF SAIGON
89 1975 CAMBODIA SEIZES "MAYAGUEZ"
90 1975 ANGOLA CIVIL WAR
91 1976 FIRST LEBANON EVACUATION (APRIL-JUNE)
92 1976 SECOND LEBANON EVACUATION (JULY)
93 1976 CAMBODIA PROTESTS BOMBING OF SIEM RAP
94 1976 SADAT ABROGATES SOVIET TREATY
95 1976 U.S. THAI BASES CLOSED
96 1976 GREECE THREATENS U.S. BASE RIGHTS TREATY
97 1976 NATO RESPONSE TO WARSAW PACT BUILDUP
98 1976 THE AEGEAN CRISIS
99 1976 "PANMUNJOM TREE" CRISIS
100 1976 USSR DEFECTOR WITH MIG-25
101 1976 NAVY LOSES TOMCAT FIGHTER FROM CARRIER
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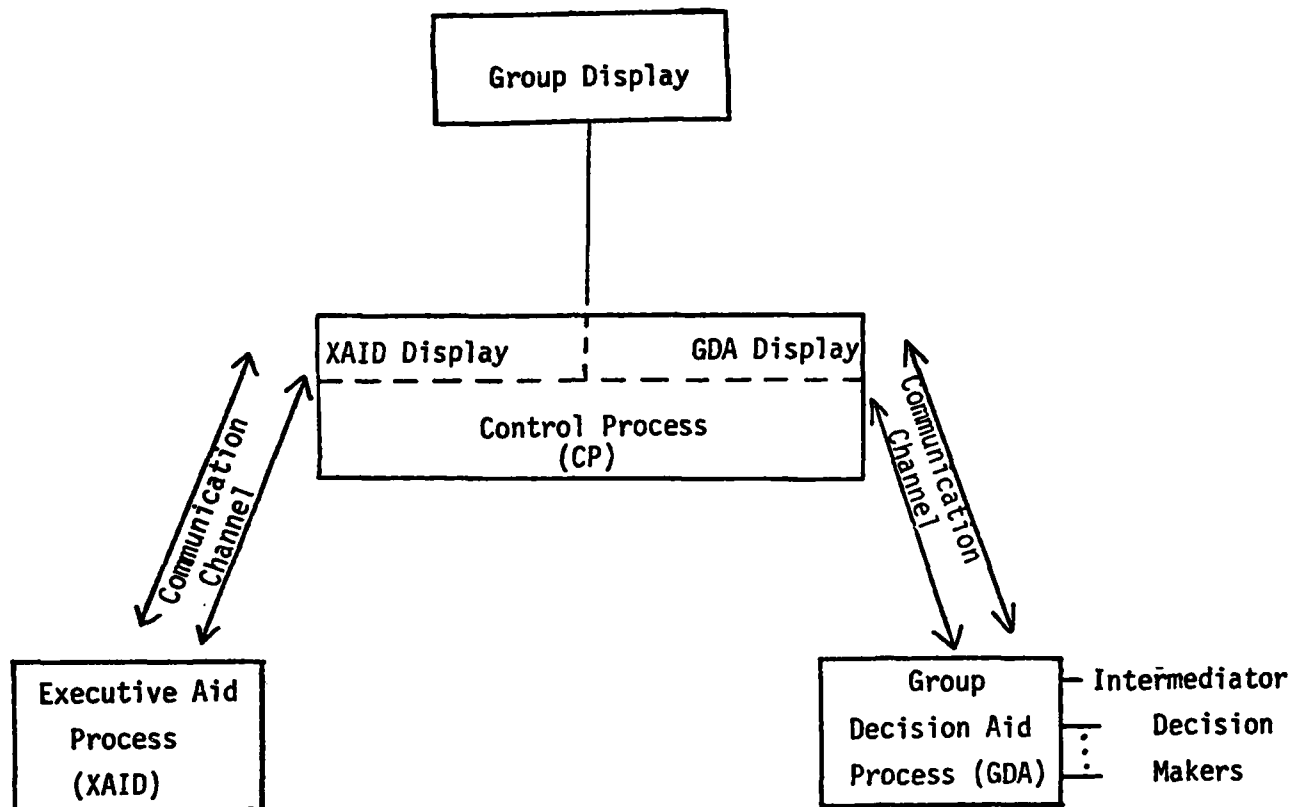
Figure 4-11

Figure 4-12

Integrated Executive and Group Aids

5. Experimental Study

5.1   Overview

An experimental study of various aspects of the group decision aid is currently under way. The experimental study is directed toward the following major objectives:

(1) To determine the relative effectiveness of alternative procedures for problem development and conflict resolution.

(2) To determine the specific contributions to problem definition, conflict resolution and decision aiding system.

(3) To aid in development of guidelines and materials for system coordination.

5.2   Intermediate Results

The performance, behavior and responses of aided and unaided groups are being compared in a complex scenario. Preliminary analysis of the findings indicate that the aided groups, interacting with the individual value entry terminals, decision guidance algorithms and large screen computer generated graphics, have come up with larger numbers of actions and events. They also consider more attributes and exhibit more unilateral participation then the unaided groups. At this point in the current evaluation the aided groups have achieved higher scores on content and process quality measures developed for the scenario by CACI.

The unaided groups tend to split into factions early and then rationalize their choices, however, their final courses of action have been similar in quality to those of the aided groups. A more detailed and comprehensive analysis of group performance will be included in the next quarterly technical report upon completion of the evaluation series.